

Zero Retries issue 0067 2022-10-07

Zero Retries is an independent email newsletter about technological innovation in Amateur Radio, for a self-selecting niche audience. It's free (as in beer) to subscribe.

About Zero Retries

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Pseudosponsor - Hackaday Supercon 2022

[Hackaday Supercon 2022](#) is the Ultimate Hardware Conference and you need to be there! The return of Supercon is taking place in just a month. We've got 45 fantastic talks and workshops planned for the three-day weekend, and they are as varied and inspiring as the Hackaday community itself.

Request To Send

Ah, October, my favorite month! The weather continues to be absolutely amazing gorgeous Fall here in Whatcom County, Washington, USA. It's like waiting for the other shoe to drop knowing that months of mostly wet, gloomy weather are imminent, but for now I'll enjoy every moment of warm sunshine and having the big doors to N8GNJ Labs open to the fresh air that I can.

de Steve N8GNJ

AREDN Nightly Build Update, and Personal AREDN Experimentation

The developers on [Amateur Radio Emergency Data Network \(AREDN\)](#) are certainly keeping busy on improving AREDN! In the **News** section (author uncredited):

Here's what's been added to the AREDN codebase since the last Production Release:

Miscellaneous fixes and updates

- Added support for extra network links to OLSR.
- Included wireguard packages in the repo.
- Fixed recoverymode script (didn't work correctly).
- Added ntp update period to basic setup page - can now choose between daily and hourly updates.
- Stopped a node from including itself in its LQM neighbors.
- Fixed bad match for NAT dhcp address.
- Added a wifi scan trigger for when the “nodes detected” count becomes zero (resets Wi-Fi).
- Added a snapshot of hostnames after OLSR updates so we have a consistent copy to display on Mesh Status page.
- Optionally include static routes (and preserve them across upgrades).

Advertised services determination logic

- Added more 3XX redirects + 401 authentication.
- If redirect ends at an https link assume it is valid.

UI changes

- Added help link to pages missing it.
- Changed support link to button.
- Updated help file for new Advanced Config format.
- Simplified Advanced Config display.
- Added units to Setup and Advanced Config pages.

If you aren't yet up and running on AREDN and want to see what some of the excitement is about, it's possible to experiment with AREDN by yourself, relatively inexpensively, to see what all the excitement is about:

The least expensive AREDN device for personal experimentation *was* the venerable and inexpensive [GL.iNet GL-AR150](#). Alas, per the manufacturer, it's now [discontinued](#). Despite its diminutive size (it fits in the palm of my hand) the GL-AR150 was a capable device. The GL-AR150-EXT had an external antenna with connector, and thus lent itself to antenna experimentation. I had a good time [learning about AREDN with my various GL-AR150 units](#).

Another device capable of running AREDN that was nearly as inexpensive as the GL-AR150s (or less expensive... I forget) is the [GL.iNet GL-USB150 “Microuter”](#). While it's not shown as discontinued by the manufacturer, they're not available on Amazon (that I can see). The Microuter is a cool device, that when flashed with AREDN firmware, presents itself to a host computer on USB as an Ethernet adapter. But it's also (as I understand it - I haven't tested this... but I should...) can be plugged into a USB power supply and it acts

as an AREDN mesh node. Thus you can set it up with a host computer, then connect it to a USB power supply and it will work standalone. It could, theoretically, be connected to a USB battery pack and then hoisted to the top of a pole and act as a relay from that point. At height, the internal antenna is less of an issue.

Both the GL-AR150 and the GL-USB150 are 2.x GHz only devices; natively they operate on 2.4 GHz, but flashed with AREDN firmware they can operate in the Amateur Radio 2.390 - 2.400 GHz band, either as two 5 MHz channels, or one 10 MHz channel.



GL.iNet GL-AR750 Creta. Image courtesy of GL.iNet

With both the GL-AR150 and GL-USB150 apparently unavailable, at least from Amazon, the next best option for personal experimentation with AREDN is the [GL.iNet GL-AR750 \(Creta\)](#). Creta has both 2.4 GHz and 5 GHz radios, but only the 2.4 GHz radio can be modified by AREDN. This is more useful than it seems, as you can access an AREDN GL-AR750 on 5 GHz via normal Wi-Fi and that connection is bridged over to the AREDN 2.4 GHz radio. As I type this, GL-AR750 is available on Amazon for \$50 each. (Search Amazon for “GL-AR750 (Creta)”. I suggest buying at least two, preferably 3 so you can really experiment with mesh networking. Note that there are some confusing variants of “GL-AR750” - the only one supported with AREDN firmware is the version pictured above.

Once you have the units, you’re in for a bit of adventure in [flashing the unit to AREDN firmware](#). The process generally works, but sometimes requires some “fiddling”. In my experimentation with the GL-AR750 units, after flashing it to AREDN firmware, sometimes I could connect to the unit via Ethernet, and sometimes not and I had to resort to attempting to connect via the 5 GHz Wi-Fi. In the end, all units were successfully flashed to AREDN. As a last resort, while it’s a bit involved, the GL-AR750 documentation includes a procedure to reflash it to original firmware.

But, “technological adventures” is kind of the point of all of this, right?

GPS Jamming - Correspondence with Time Nut John Ackermann N8UR

Amateur Radio is using GPS a lot more than it used to, primarily for high-resolution time synchronization for experimentation on HF, such as [Weak Signal Propagation Reporter \(WSPR\)](#), and more recently, the plan to use it for experiments on HF by [Ham Radio Science Citizen Investigation \(HamSCI\)](#).

Thus, one of the presentations I enjoyed from DCC 2022 a few weeks ago was by John Ackermann N8UR - Using a GPS as an RF Source: Possibilities and Pitfalls. As background, N8UR cheerfully confesses to being a “[Time Nut](#)”, Amateurs (not necessarily Amateur Radio Operators) who are interested in measurement of precise time and frequency.

I wrote to N8UR:

While it’s not an issue for something like the Tangerine SDR used for research and experimentation for Amateur Radio (and academia), I’m starting to get nervous about assuming GPS is always going to be available for “critical” systems like digital voice repeaters.

This article is just the latest to sound the alarm - [GPS Jammers Are Being Used to Hijack Trucks and Down Drones](#).

Is it possible to build systems that use GPS when it’s available, but don't degrade catastrophically when GPS is jammed? And is it possible to know GPS is being jammed (like if a fixed device moves significantly, can you assume that GPS is being tampered with)?

N8UR replied (reprinted with permission):

In short, the u-blox receivers have some capability of detecting and reporting interference. I've never played with it so not sure just what it can do. I don't know what that does for immunity, but at least it provides some indication there's a problem.

While most timing systems still use GPS only, GLONASS can do a thoroughly good job, as long as you trust the Russians. You can take it from there... Galileo and Beidou can provide timing, though the experience with them is much less. The UTC realization across all the systems is close enough that you're not going to see a timing difference between them.

Apart from multiple constellations providing some backup capability, the new frequencies should help. The L2C signal is supposed to be more robust and provides a backup to L1C/A. L1C has better SNR capabilities, and L5 is in a different frequency band and has a significantly higher power. So the three of those should improve the robustness and make it harder to completely jam reception.

If all else fails, most GPSDOs have some sort of holdover capability to keep the oscillator relatively stable during outages. The best of them learn the XO aging rate, and sometimes have temp sensors, so they can intelligently adjust the frequency during an outage. They need that to meet the telco standard of some uS time offset in 24 hours.

The chip we're using in TangerineSDR isn't that sophisticated, but it retains up to (IIRC) 60 seconds of prior history to inform short term steering if there's an outage. That's probably mainly useful to avoid abrupt phase jumps when the system goes in and out of lock.

Despite all that, count me in the camp that thinks we need to bring up eLoran as a backup system. I've heard talk of Starlink as a navigation aid, but I have no idea how that would work and whether it would yield timing information. I'd think the high doppler from those low orbits would be a problem.

I'm slightly less nervous about GPS now.

First Results – World's Largest Jammer (& Spoofing) Test

This came on my RADAR recently, and seemed a good complement to the correspondence with N8UR.

I was aware that governments and especially militaries (of course) were well aware of and studying the potential for havoc of jamming, but I wasn't aware that there was a civilian organization dedicated to such studies - [The Resilient Navigation and Timing Foundation](#). It was interesting to see the [results of a recent test](#):

Industry from all over Europe met when the Norwegian Public Roads Administration, the National Communications Authority and the Norwegian Defense Research Institute tested how modern position and time technology withstands jamming and spoofing attacks last week.

The event "Jammest 2022" took place at the town of Bleik on Andøya from 19 to 23 September 2022 and brought together authorities, car manufacturers and international technology suppliers from all over Europe for GNSS jamming – and spoofing. It is the first time a civilian jamming test of this scale has been carried out in Norway.

Jamming is interference or blocking of, among other things, radio and GPS signals, while spoofing is sending out false signals to deceive the receiver who receives these signals.

Cars, drones, helicopters and other equipment have been exposed to jamming and spoofing attacks, says senior engineer Nicolai Gerrard at the National Communications Authority, Nkom.

The aim of the test is increased security and more robust systems. By exploring, for example, how jamming in different compositions (of radiated power, frequency bands and signal modulations) affects these different technologies, one can explore connections in the underlying systems and discover which parameters give an indication of which attacks.

In addition to creating intentional disturbances through jamming, we took over clocks and

navigation systems using spoofing, and this has produced many interesting results. We see that some systems stand up to the attacks better than others, and have received some indications about what makes some systems robust, and what the systems that have been easier to take over lack in order to resist spoofing, says Gerrard.

ZR > BEACON

- [The Thorny Problem of Keeping the Internet's Time](#) - My thanks to Jeff Davis KE9V not only for spotting this excellent New Yorker article (wow - they *do* do tech!), but [sussing out that the subject of the article, David Mills is W3HCF](#). Excerpt:
In 1977, David Mills, an eccentric engineer and computer scientist, took a job at COMSAT, a satellite corporation headquartered in Washington, D.C. Mills was an inveterate tinkerer: he'd once built a hearing aid for a girlfriend's uncle, and had consulted for Ford on how paper-tape computers might be put into cars. Now, at COMSAT, Mills became involved in the ARPANET, the computer network that would become the precursor to the Internet. A handful of researchers were already using the network to connect their distant computers and trade information. But the fidelity of that exchanged data was threatened by a distinct deficiency: the machines did not share a single, reliable synchronized time.
 - **Digital Library of Amateur Radio & Communications gets its Public Relations campaign going!** Apparently the mentions in the tech press originated from an Internet Archive blog post - [Internet Archive Seeks Donations of Materials to Build a Digital Library of Amateur Radio and Communications](#). That led to mentions of DLARC in [Hackaday](#), [Engadget](#), [Gizmodo](#), [Hacker News](#), and an ["In Brief" mention in the ARRL Letter](#).

But... there's still no "DLARC portal" on the Internet Archive to be able to browse digitized Amateur Radio material. Amateur Radio material is being aggregated into Internet Archive, especially from sources already online, but (as far as I'm aware) there is no dedicated DLARC section of Internet Archive. Thus searching for Amateur Radio material on Internet Archive remains a "treasure hunt - easy if you know what you're looking for (like 73 Magazine), but no easy way to browse Amateur Radio material assembled as part of the DLARC project.
 - [Is Ham Radio Paying Attention To This MAJOR SHIFT in Communications?](#) YouTube video by Matt Kaskavitch K0LWC regarding the Apple / Globalstar collaboration.
 - [You Can't Buy a Raspberry Pi — Why?](#) YouTube video by Jeff Geerling - good overview on the Raspberry Pi unobtainium situation, and he got his info straight from the source of all wisdom on Raspberry Pi.
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Updata - FPGA is *Field Programmable* Gate Array

In Zero Retries 0066 Request to Send, I said:

This issue *isn't only about the use of Pactor 4* on HF; Amateur Radio is constantly developing new data communications technologies using ever-more-capable digital systems such as the [TangerineSDR](#) that uses a very powerful Floating Point Gate Array (FPGA) to digitize the entire HF band through 54 MHz *simultaneously!*

The correct meaning of FPGA is *Field Programmable* Gate Array. This is a recurring mental glitch of mine - apologies.

Thanks to Zero Retries reader "don't quote me by name" for spotting this and notifying me.

Zero Retries Sponsorships

The Zero Retries sponsorship model is *evolving*, but it's initially inspired by the [Daring Fireball blog's sponsorship model](#) (other than this sponsorship cost). Some initial points:

Sponsorship of Zero Retries is only available to "Zero Retries Interesting" companies, organizations, individuals, and projects. Ideally, a Zero Retries sponsor is involved in Amateur Radio, but that's not an absolute requirement. If an individual or company would like to sponsor Zero Retries, but prefer to remain anonymous, that's acceptable, but the "Zero Retries Interesting" criteria still apply.

- Sponsorships are limited to a *brief* mention in Zero Retries - a few sentences at most (but prominently displayed). Example - "WhizzyPacket is proud to sponsor this week's Zero Retries". More targeted sponsorship messages are acceptable, such as "WhizzyPacket is looking for a few good engineers - click here".
- A sponsorship is for *one* weekly issue of Zero Retries and is exclusive - one sponsor per week. Sequential sponsorships are available - as much as three months of sponsorship is acceptable. Longer than three months, let's discuss it.
- Lastly, although it kind of defeats the overt purpose of sponsorship, if a *Zero Retries Interesting company, organization, individual, or project cannot afford to pay for a sponsorship*, but wants / needs to "get the word out", Zero Retries can probably work something out. In fact, if there are gaps in sponsorships, I'll probably create some gratis sponsorship messages.

If you are interested in sponsoring Zero Retries, please reach out - it's early days. More importantly, if you know of a company, organization, project, or individual that you think could / would / should sponsor Zero Retries, *please point out Zero Retries to that entity*.

Join the *Fun* on Amateur Radio

If you're not yet licensed as an Amateur Radio Operator, and would like to join the fun by *literally having a license to experiment with radio technology*, check out

Join the Fun on Amateur Radio for some pointers.

Closing the Channel

In its mission to highlight technological innovation in Amateur Radio, promote Amateur Radio to techies as a literal license to experiment with wireless technology, and make Amateur Radio more relevant to society in the 2020s and beyond, Zero Retries is published via email and web, and is available to anyone at no cost. Zero Retries is proud *not to participate* in the Amateur Radio Publishing Industrial Complex, which hides Amateur Radio content behind paywalls.

My ongoing *Thanks* to:

- Tina Stroh KD7WSF for, well, *everything*!
- Pseudostaffer [Dan Romanchik KB6NU](#) for continuing to spot, and write about "Zero Retries Interesting" items on his blog that I don't spot on my own.
- [Amateur Radio Weekly](#) and [Southgate Amateur Radio News](#) consistently surface "Zero Retries Interesting" stories.
- The [Substack email publishing platform](#) makes Zero Retries possible. I recommend it for publishing newsletters.

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More bits from Steve Stroh N8GNJ:

- [SuperPacket blog](#) - *Discussing new generations of Amateur Radio Data Communications - beyond Packet Radio (a precursor to Zero Retries)*
- [N8GNJ blog](#) - *Amateur Radio Station N8GNJ and the mad science experiments at N8GNJ Labs - Bellingham, Washington, USA*

Thanks for reading!

Steve Stroh N8GNJ / WRPS598 (He / Him / His)

These bits were handcrafted in beautiful Bellingham, Washington, USA

2022-10-07

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